SUBSTITUTE SPECIFICATION WITHOUT MARKINGS

TITLE OF THE INVENTION

ELECTROLYTIC APPARATUS FOR MOLTEN SALT

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an electrolytic apparatus for molten salt, more particularly to an electrolytic apparatus for molten salt, which can be compact, with excellent sealing property.

DESCRIPTION OF THE RELATED ART

Fluorine gas is an indispensable basic gas in the semiconductor manufacturing field. Further, fluorine gas is used for the semiconductor manufacturing field independently, but nitrogen trifluoride gas (hereinafter referred to as NF_3 gas) is synthesized based on fluorine gas. The demand for cleaning gas and dry etching gas to be used in semiconductor industry is increasing rapidly. Also, neon fluoride gas (hereinafter referred to as NeF gas) and krypton fluoride gas (hereinafter referred to as KrF gas) or the like are excimer laser oscillator gases, which are used for the patterning process for producing a semiconductor integrated circuit.

Fluorine gas and NF_3 gas which used for manufacturing semiconductors are required for high purity. Also, a required amount of fluorine gas, filled up in a gas cylinder, is taken out and used at the manufacturing site. Accordingly, the management of storage places for the gas cylinder, security of the gas, and purity maintenance is very important.

Furthermore, as the demand of NF_3 gas is rapidly increasing, there are problems such as storage supply and the use of fluorides in view of global warming. Additionally fluorine gas is being used more widely in many applications. In view of these problems, fluorine gas generator on demand is preferable to treat the high pressure fluorine gas stuffed in the cylinder in for improvement of security and convenience of degree of freedom for gas supply.

Conventionally, fluorine gas is generated by an electrolytic cell as shown in Fig. 6. For the material of the main part of the electrolytic cell 201, nickel (hereinafter referred to as Ni), Monel, carbon steel or similar materials are generally used. A heater and / or a cooling device 214 is disposed surrounding the electrolytic cell body 201 to keep the temperature of the electrolytic bath 202 constant and to be capable of electrolysis. Also, the electrolytic cell body 201 is divided into an anode chamber 210 and a cathode chamber 211 by partition wall 209 made of Monel or the like. The fluorine gas is generated by electrolyzing the electrolytic bath 202, in which an electric voltage is applied between the anode 203, made of carbon or nickel disposed in the anode chamber 210, and the cathode 204, consisting of iron or nickel disposed in the cathode chamber 211.

However, as in the case of disposing the fluorine gas generator in the semiconductor manufacturing plants, there are many restrictions for installation conditions. Therefore, it is very important to make the gas generator compact. To make the electrolytic apparatus compact, it is necessary to consider rearrangement of the heat exchanger parts.

Usually, the temperature of the electrolytic bath in the electrolytic cell is being kept constant by a heating apparatus such as heater or the like which is disposed around the electrolytic cell to control the electrolyzing condition by maintaining

temperature of the electrolytic bath in the gas generator. Also, preventing the rapid temperature change in the electrolytic cell by using heat insulator disposed around the electrolytic cell (including heater) is necessary to improve energy efficiency and to prevent the burning of operators due to rapid temperature rise. Generally, asbestos, urethane or the like is used for heat insulator, the insulating performance is not only inadequate, but also there is a problem of working environment such as a scattering of the particles or the like which are formed of fibers or coarse particles.

Also, according to conventional industrial electrolytic cell, sealing material, such as shape packing, is used for the gas generating parts in electrolytic cell for keeping the invasion of an atmospheric gas such as air or the like outside of the electrolytic cell and preventing the leakage of the gas such as fluorine or hydrogen from the electrolytic cell. However, the airtightness of the electrolytic cell may be inadequate, even if shaped packings are used. Also, in many electrolytic cells used today, electric insulation of connection between electrodes for electrolyzing and terminal is not enough.

Accordingly, the purpose of the present invention is to provide an electrolytic apparatus for molten salt which can be compact. Also, the purpose of the present invention is to provide an excellent electrolytic apparatus for molten salt having an electric insulation, gas sealing and security against heat and generated gas.

SUMMARY OF THE INVENTION

The purpose of the present invention is to provide a compact electrolytic cell body, heat insulation structure such as heat exchanger parts, improvement of electric insulation, gas leakage and work safety.

Namely, the present invention relates to an electrolytic apparatus for molten salt having an electrolytic cell to electrolyze an electrolytic bath consisting of a mixed

molten salt comprising a first heat exchanging means to heat and/or cool the electrolytic cell body, and an outer frame disposed outside of the first heat exchanging means with space and to seal the first exchanging means, and a heat insulating zone capable of decompression or vacuum formed inside the outer frame. According to the present invention, since the electrolytic cell has a decompression or vacuum heat insulation structure, coefficient of thermal conductivity can be extremely low compared with the heat insulator such as asbestos or urethane. As the result, thickness of the heat insulating zone can be thin. Therefore, electrolytic cell can be compact and working safety is improved. Further, the heat energy loss of the electrolytic cell body can be decreased. Also, there are no particles. In addition, in this invention, heat exchanging means for heating and/or cooling the both of the electrolytic cell body is provided. As a result, the efficiency of heat exchanging can be improved by combination of heating and cooling of electrolytic cell with first heat exchanging means. Further, target pressure by decompression or vacuum, approximately 10kPa-1000 Pa is preferable. When the pressure of heat insulating zone is less than 10kPa, the thermal conductivity by gases cannot be lowered, which decreases the efficiency of heat insulation. Also, to make the pressure of heat insulating zone less than 100Pa, another large equipment is required, resulting in high cost. Accordingly, to decompress the pressure of heat insulating zone, 10kPa to 1kPa is preferable.

Also, the present invention relates to the electrolytic apparatus for molten salt, wherein the electrolytic apparatus may further comprise a second heat exchanging means to heat the electrolytic cell body. The second heat exchanging means according to the present invention is provided in case it is difficult to heat only with the first exchanging means, or in case that further precise temperature controlling is

required, like heating, cooling or to capable to change, such as heating parts disposed on the bottom of electrolytic cell body, a heater disposed on the pipe for supplying the HF can be shown in for example.

Further, the present invention relates to the electrolytic apparatus having the electrolytic cell body for electrolyzing the electrolytic bath consisting of the mixed molten salt, the electrolytic apparatus comprises the first heat exchanging means to heat and/or cool the electrolytic cell body, and a part which is required for electrical insulation and gas insulation simultaneously. An electrolytic insulating material described in the present invention is defined as a material such as volume specific resistance value which is not less than 10^6 Ω·m measured by JIS K 6911. Also, as an electric insulating material, having a corrosion resistance characteristic against generated fluorine gas is preferable, fluoride rubbers, fluorocarbon resin like polytetrafluoroethylene (hereinafter referred to as PTFE), PFA (tetrafluoroethylene-perfluoro (alkyl vinyl ether) copolymer) are shown asexamples. By inserting the electric insulating material between electrolytic cell body and upper lid, electrical insulation is improved. Furthermore a material should have an airtightness and an elasticity is more preferable, such as fluorinated rubber, for example. The gas sealing material should preferably be disposed where fluorine gas, HF gas or the like are likely to leak. Also, the gas sealing property is defined as a degree of pressure change after temperature compensation is within ± 1 %, when the gas pressure of 1.1 times or more than usual operating pressure within nitrogen gas atmosphere and keeps for 24 hours in the electrolytic apparatus. By this construction, invasion of outside gas in the electrolytic cell is controlled, which improves impurity of the generated gas. Also, by electrolyzing the electrolytic cell, the generated gas cannot easily leak out from the

electrolytic apparatus, as the result, an improvement of working environment and security can be improved.

Furthermore, the present invention relates to an electrolytic apparatus for molten salt comprising an electrolytic cell to electrolyze the electrolytic bath consisting of a mixed molten salt, wherein the electrolytic apparatus having the electric insulating material and the gas sealing material, in case of the electric insulating property and gas sealing property are required in the electrolytic cell simultaneously. By this construction, the electric insulating effect, airtightness, the purity of the generated gas and security can further be improved.

Also, the present invention relates to the electrolytic apparatus for molten salt comprising a flow line to flow a heat exchanging medium in the first heat exchanging means surrounding the electrolytic cell body. By this construction, by circulating the heat exchanging medium, heating and/or cooling the electrolytic cell is easy andeffective. As a result, melting of salt used as the raw material of electrolytic bath and removal of generating heat by electrolyzing can be carried out effectively.

Further, the present invention relates to the electrolytic apparatus for molten salt, wherein the heat exchanging medium is a fluid consisted of high electric insulating material. By this construction, short-circuiting from heat medium can be prevented, when the electrolytic cell body becomes cathode. For the electric insulating material, liquids such as water (pure water or distilled water) fluorinated oil, silicone oil, or gases such as Ar gas or He gas may be used, but is not limited to these materials. In addition, to consider easy access, using water is preferable. Using pure water is more preferable.

Also, the present invention relates to the electrolytic apparatus for molten salt, wherein the electrolytic cell is disposed in the box whose upper part is open. The

purpose of adopting such box is to separate the electrolytic cell from outside of the electrolytic cell. The box material is not limited, but it is necessary to have the corrosion resistance and heat resistance against the generated gas by generating and electrolytic bath component, metal such as a stainless, PTFE, is shown as an example. Also, in order to prevent the leak of electrolyte, disposing the box at the bottom of the electrolytic cell is preferable.

Further, the present invention relates to the electrolytic apparatus, wherein a mixed molten salt comprise a hydrogen fluoride.

According to the present invention, as the effect of insulation is improved by forming the heat insulating zone, it is possible to make the apparatus more compact than conventional electrolytic apparatuses. Accordingly, the heat discharge to the outside can be dropped, and the electrolytic cell is heated effectively, as the result, the waste of energy can be minimized by heat exchanging means. Also, as the heat insulating zone is decompressing, scattering of the particles, which is one of the deteriorating factors, can be prevented in the semiconductor manufacturing process. Further, by means of consideration, gas sealing material, electric insulating material and gas sealing property are improved, and the high purity gas can be obtained. Furthermore, the gas leakage can be prevented. As a result, it is possible to use the apparatus at the semiconductor manufacturing site.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is an outer elevational, partially cross-sectional view of the principal part of the fluorine gas generator relating to the present invention.

Fig.2 is a perspective view of the electrolytic cell showing the internal structure of the outer frame, according to the present invention.

Fig.3 is a cross sectional view of the electrolytic cell body according to the present invention.

Fig.4 is an expanded cross sectional view of part A shown in Fig.3. Fig.5 is an expanded cross sectional view of part B shown in Fig.3. Fig.6 is a schematic cross sectional view of the fluorine gas generator which was being used conventionally.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, based on the drawings 1 - 5, preferred embodiments of the present invention relating to the fluorine gas generator are described more in detail.

The construction of fluorine gas generator (an electrolytic apparatus for molten salt) is shown in Fig.1. 1 is an electrolytic cell consisting of electrolytic cell body la and upper lid 17, and 2 is an electrolytic bath consisting of mixed molten salt made of KF-2HF type, 3 is an anode chamber, 4 is a cathode chamber, 5 is an anode, 6 is a cathode. 22 is an outlet port for C-1 generated fluorine gas in anode chamber 3. 11 is a thermometer to measure the temperature in the electrolytic bath 2, 13 is a heat exchanging means of electrolytic cell 1, 12 is an apparatus for warm water heating to supply the warm water for heat exchanging means 13. 51 is a warm water jacket disposed on the side of electrolytic cell 1, which constructs heat exchanging means, 52 is a heating parts (secondary heat exchanging means), which constructs heat exchanging means 13 and disposed outside of the bottom of electrolytic cell 1.

The electrolytic cell 1 is made of a metal such as Ni, Monel, pure iron or stainless steel. Inside of the electrolytic cell 1, separator 16 made of Ni or Monel divides into the anode chamber 3 and the cathode chamber 4 in the center of the electrolytic cell 1. An anode 5 is disposed in the anode chamber 3, and a cathode 6 is disposed in the cathode chamber 4. For the anode 5, low polarized carbon electrode is

preferable. Also, cathode 6 preferably consists of Ni machined into predetermined shape.

A flange part lb connected to a circumferential edge of the upper lid 17 is formed on the upper circumference of the electrolytic cell body la. A concave groove 1c shown in Fig.2 and Fig.3 surrounds the plane of the flange part lb side, which is connected to upper lid 17.

The upper lid 17 shown in Fig.3 and Fig.4 is placed and fixed to the screw part 31 and to the flange part lb by bolt 30, and a electric insulating bushing 32 is placed between bolt 30 and upper lid 17. Since the upper lid 17 and electrolytic cell body la are connected by bolt 30 at a squeezing strength of 5 - 30 N · m with the electric insulating material 32, placed there between (the upper lid 17) is insulated electrically without hurting an insulation resin. Also, electric insulating material 9 and gas sealing material 10 are placed between flange part lb and circumferential edge of upper lid 17. As this gas sealing material 10, O ring made of fluorinated rubber having a corrosion resistance against the fluorine gas is used for and disposed in the groove 1c of flange 1b. In addition, on the plane of upper lid 17 of flange part 1b, plurality of screw parts 31 are formed at a predetermined interval and upper lid 17 is fixed to flange part lb with same number of bolts 30.

Also, electric insulating material 9 (wherein right and left both sides in Fig.3), which is disposed surrounding the inside and the outside of gas sealing material 10, and is disposed along the interstice between flange 1b and upper lid 17. For this electric insulating material 9, polytetrafluoroethylene (PTFE) or the like can be used.

By placing the electric insulating material 9 and gas sealing material 10 between upper lid 17 and electrolytic cell body la, upper lid 17 can be easily removed from the electrolytic cell body la. Also, by placing the gas sealing material 10

between electrolytic cell body la and upper lid 17, fluorine gas, hydrogen gas and HF gas or the like cannot leak out of the electrolytic cell 1, and a gas outside cannot invade into the electrolytic cell 1. Further, the short-circuiting between upper lid 17 and electrolytic cell body la is prevented by electrical insulation such as an electric insulating material 9.

As shown in Fig. 1, an outlet port 22 for generated fluorine gas from anode chamber 3, and an outlet port for generated hydrogen gas from cathode chamber 4, and HF introducing port 25 of HF feed line 24 to feed HF, and pressure gauges 7, 8 to detect the pressure inside of the anode chamber 3 and the cathode chamber 4 respectively, are disposed to the upper lid 17 on the electrolytic cell 1.

Also, as shown in Fig. 5, almost at the center of the upper lid 17, an opening part 35 is formed to insert the anode 5 into the electrolytic cell body la, and a cover body 36 is disposed to cover the opening part 35. A connecting rod 37 to which anode 5 is attached is provided perpendicularly to this cover 36. L-shaped cross section attachment 38 is provided at the lower end of connecting rod 37, to which upper part of anode 5 is attached by connecting bolt 39 penetrating through holes (not shown) of the upper part of the anode 5.

The above-mentioned electric insulating material 9a and 0 ring 10a, analogous to electric insulating material 9 and gas sealing material 10, are disposed between this cover body 36 and the upper lid 17. Thus, by placing the electric insulating material 9a and 0 ring 10a between cover body 36 and upper lid 17, gas such as fluorine gas and hydrogen fluoride gas in the electrolytic cell 1 do not leak out, and permeation of the air into the electrolytic cell 1 can be prevented. Also, the cover body 36, which surface is being applied by an insulation paint, and electrical connecting part (terminal

stand), which is covered with the resin material of electric insulation, prevents short-circuiting with outside.

The gas outlet ports 22, 23 disposed on the upper lid 17 have tubes which are formed of the material having the corrosion resistance against the fluorine gas, such as stainless steel or the like. Also, the HF feed line 24 is covered with a thermo controlling heater (secondary heat exchanging means) 24a to prevent the HF from liquefaction.

The heat exchanging means 13 shown in Fig. 2 is constructed with the warm water jacket 51, which surround the electrolytic cell 1. The heating parts (secondary heat exchanging means) 52 are disposed on the bottom of electrolytic cell 1.

The warm water jacket 51 comprises a warm water pipe (first heat exchanging means) 53 which has a stream line 53a (referred to as Fig.3) which can flow a heat medium, and a vacuum insulating zone 55 formed inside of an outer frame 54 having a sealed warm water pipe 53, and surrounding with space furthermore to the warm water pipe 53.

The warm water pipe 53 is disposed surrounding the side of electrolytic cell 1 horizontally and at the fixed interval, and connects each other at the connection part (not shown) and connected. Also, as the material of the warm pipe 53, material having an excellent thermal conductivity like copper is preferable, but it is not limited, metal pipe, such as iron, stainless steel, aluminum or the like can be applied, for example.

As shown in Fig.2, the shape of warm water pipe 53 is preferably rectangular. When the shape is a rectangular cross-section, contact area with the side of electrolytic cell 1 can be made larger. As a result, the thermal energy of thermal medium can be conducted for the electrolytic cell 1 effectively, but the shape is not

limited. A circle pipe, a triangular pipe, a semicircular pipe by cutting half with the surface which goes through the main axis in the circle pipe can be applied, for example. Namely, if the pipe is semi-circular, by disposing the semi-circular pipe side of the electrolytic cell 1, the aisle, which includes the surrounding of the electrolytic cell 1 can be formed between semi-circular pipe and surrounding of the electrolytic cell 1. The heat medium hereafter mentioned flows in this aisle and serves as the warm water pipe 53.

Also, the warm water pipe 53is equipped along the longitudinal direction generally by welding having a welding part side of the electrolytic cell 1. The sealing material having a high thermal conductivity is placed between two welding parts along with the longitudinal direction of the warm water pipe 53. Thus, by placing the sealing material, the contact area between warm water pipe 53 and the side of electrolytic cell 1 can be made larger and the efficiency of thermal conductivity from the warm water pipe 53 can be improved.

Further, the semi-circular pipe can be also attached surrounding the electrolytic cell 1 along the longitudinal direction regularly by welding. By filling up the sealing material between two welding parts, the leakage of the heat medium from the aisle can be prevented and the heat energy of the heat medium transmitted to the semicircle pipe can be transmitted to the electrolytic cell 1 by placing the sealing material like said warm water pipe 53.

Also, heated heat medium with the warm water heating apparatus 12 shown in Fig. 2 is being circulated in the aisle of warm water pipe 53. This heat medium consists of pure water, and the warm water 56 heated at the warm water by heating apparatus is being circulated in the arrowed direction shown in Fig. 2.

Since the heat medium is being circuited in the aisle 53a of the warm water pipe 53 of the first heat exchanging means, the first heat exchanging means can be cleaned and sealed. Also, by using the pure water for heat medium, electrolytic cell body la and the heat medium are insulated electrically, and electrical short-circuiting between electrolytic cell body la and heat medium can be prevented. Since the pure water does not contain the impurity and almost does not conduct electricity, the electric current is not conducted from the warm water apparatus 12 by using the pure water. Therefore, the generation of the electrical leakage between electrolytic cell body la and heat medium such as pure water can be mostly prevented.

In addition, the pipe from the warm water heating apparatus 12 connecting with warm water pipe 53 can be insulated electrically by using the pipe which is an insulating material itself or connection with the insulating material between the two pipes. Also, in the preferred embodiment, polytetrafluoroetylene (PTFE) hose is adopted for the pipe. Further, the electric insulation resistance increases as the length of tube is getting longer. Therefore, the length between warm water apparatus 12 and electrolytic cell 1 should be 10 centimeters or more ispreferably, 30 centimeters.

Further, the check valve is disposed in the outer frame 54(not shown), vacuum insulating zone 55 is formed to be decompression or vacuum insulating layer by vacuuming the air with decompression machine or the like shown in Fig.1 from the vacuum insulating zone 55 which is formed between outer frame 54 and warm water pipe 53. As a result, the heat generated by flowing the heat medium to the aisle 53a in the warm water pipe 53 almost cannot be emitted to the outside, and the electrolytic cell 1 is heated effectively by warm water pipe 53 contacted with electrolytic cell 1. Since the vacuum insulation zone 55 is decompression or vacuum, the particles from the insulating layer to be one of the factors is not generated in the process for

manufacturing the semiconductor. Therefore, it is possible to use the generator on-site in the process for manufacturing the semiconductor. Also, as the warm water pipe 53 is being surrounded by outer frame 54, the temperature of the atmosphere surrounding the electrolytic cell 1 is not only being raised, but also kept clean. Therefore, as it is possible to prevent the workers from burning or the like, safety is improved.

A heating part 52 which is consisted of a rubber insulating layer 52a disposed on the bottom of electrolytic cell body 1, and a heating layer 52b which has a nichrome wire disposed all faces inside, and laminated and shaped plate like. The bottom of the electrolytic cell 1 is heated by the heating part 52, which is supplied with electric power from an electric power source (not shown) and via insulating layer 52a. Accordingly, a heat emission from the bottom of electrolytic cell 1 is prevented by heat parts 52. Also, as the shape of the heat part52 is plate like, the bottom surface of electrolytic cell 1 is placed stably.

Further, the warm water heating apparatus 12 which supplies the warm water heating the pure water to the warm jacket 51 comprises, a heat medium heating means (not shown) in the warm water jacket 51 and thermo controlling apparatus (not shown) which controls the heat medium heating means. Furthermore, warm water heating apparatus 12, which is connected with thermometer 11 which measures temperature of the electrolytic bath 2 in the electrolytic cell 1 warm water jacket 51 which heats the electrolytic bath 2 in the electrolytic cell 1, and provides warm water 56 into the warm water jacket 51 to maintain the temperature of the electrolytic cell 1 based on the thermal information of thermometer 11. Further, by providing the pressure controlling function to the warm water heating apparatus 12, the tube can be connected with warm water heating apparatus 12, warm water pipe 53 and other tubes

in the sealed condition. By heating the warm water, from the warm water pipe 53 sealed and connected to warm water heating apparatus, in the case of the pressure rising in the tube (warm water pipe), this pressure is eased by warm water heating apparatus 12. Also, in the case of cooling the warm water, the pressure of warm water pipe is dropped, in this case, the pressure is compensated by warm water heating apparatus 12. By providing the function like this, without decreasing warm water due to the vaporization of warm water at the time of heating, and the permeation of the air or the like can be prevented by decompressing in the tube at the time of the cooling. By this construction, it is not necessary to compensate with warm water or the like, the contamination from the substance outside can be prevented. As a result, the corrosion of the warm water pipe 53 or the like can be prevented.

Thus, as the warm water jacket 51 which has the decompression or vacuum thermally heat insulating structure, the coefficient of thermal conductivity of the insulation zone is extremely minimized than insulation zone which is made of the material such as asbestos, urethane or the like, the thickness of the insulating zone 55 itself can be thinned. Therefore, the electrolytic apparatus can be compacted, the security is improved, and a loss of heating energy can be reduced. Also, generating of the particles from insulating material is prevented.

The electrolytic cell 1 described above is contained in the box 60 with upper open shown in Fig. 1. This box 60 has a bottom plate 61 which is a slightly larger rectangle shape than the bottom of electrolytic cell 1, and four side plates 62 which are slightly larger rectangle shapes than the side of electrolytic cell 1, and the connection part between bottom plate 61 and 4 side plates 62 sealing material is being placed from inside. Since the sealing material is provided in this connection part, the water leakage from the box 60 can be prevented.

The material or the shape of the box 60 is not limited specifically, but it is necessary to contain the electrolytic cell body la and to prevent the spread warm water jacket 51 or the connection part between the pipe from warm water heat apparatus 12 and warm water jacket 51 from the leakage of warm water. By this construction, the leakage to the outside of the heat medium such as the pure water heated (warm water 56) or the like from warm water pipe 53 can be prevented.

Next, the preferable embodiment of the operation for the fluorine gas generator. By applying the voltage between the anode 5 and the cathode 6 in the electrolytic cell 1, the fluorine gas is generated from anode 5, and hydrogen gas is generated from cathode 6, under the normal conditions. The fluorine gas generated from anode 5 is supplied to the line from the fluorine gas outlet port 22 of the upper part of the anode chamber. Also, the hydrogen gas generated from cathode 6 is supplied to the line from the hydrogen gas outlet port 22 of the upper part of the anode chamber.

And, as the decreasing of the electrolytic bath 2 by means of continuous electrolyzing, liquid surface level detective means (not shown) is operated. By this linkage, HF is supplied to the electrolytic bath 2 from HF supply line 24 via HF outlet port 25. Thus, as the HF decreasing such as the material for electrolyzing depends on by electrolyzing between the anode 5 and the cathode 6 in the electrolytic bath 2, HF is introduced to the electrolytic bath 2 continuously and HF concentration in the Electrolytic bath 2 is being kept at the optimal condition. As the result, the condition of electrolyzing is always stabilized.

Also, to carry out the electrolysis with electrolytic bath 2 efficiently, electrolytic bath 2 is heated to an optimal temperature by heat exchanging means 3 via electrolytic cell 1. The electrolytic bath 2 is kept at the optimal temperature by the

thermometer 11 to monitor the temperature in the electrolytic bath 2, and warm water heating apparatus 12 to heat the pure water supplying to the warm water jacket 51, and a plate like heating part.

Also, as the warm water jacket 51 which has the decompression or vacuum zone 55 due to the outlet 54, the heat energy generated can be connected (heated) efficiently, via the surrounding outside of the electrolytic cell 1 and temperature rise of the warm water jacket surrounding outside can be prevented. Accordingly, the aggravation of the atmosphere surrounding of the heat exchanging means 13 is not only prevented, but also the energy loss of the heat exchanging means 13 can be prevented, and the electrolytic bath is kept at an optimal temperature. As a result, electrolysis can be carried out by anode 5 and cathode 6 efficiently, and fluorine gas can be generated stably.

In addition, although the electrolytic apparatus for molten salt accordance with the present invention is mainly explained fluorine gas generator to generate the fluorine gas by electrolyzing, the present invention is not limited to the fluorine gas generator. Also, the warm water heating apparatus 12 to supply the warm water 56 to the warm water jacket 56 is not only for heating, but cooling for the medium is also possible. By applying the warm water heating apparatus, the temperature adjustment of the electrolytic bath 2 in the electrolytic cell 1 can be carried out promptly.